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Value Addition and Strategic Development of Sorghum Processing in Pangkep Regency, Indonesia

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Sorghum is a climate-resilient food crop with significant nutritional and economic potential but remains underutilized in Indonesia. This plant has high tolerance to drought and good nutritional value, and can be processed into economically valuable products. This study aims to analyze the added value of processing sorghum seeds into derivative products such as rice and flour, and to formulate a SWOT-based sorghum agroindustry development strategy. This study was conducted at CV Sorgum in Pangkep Regency, South Sulawesi, using a case study approach integrating descriptive and quantitative methods. Value-added calculations were performed using the Hayami method, while strategy formulation was based on SWOT analysis to assess the strengths, weaknesses, opportunities, and threats of the business. Results indicated that sorghum flour yielded the highest added value, at Rp 12,797.04/kg, compared to Rp 6,137.88/kg for sorghum rice. The SWOT analysis placed CV Sorgum in Quadrant I, recommending an aggressive strategy as the primary approach. The proposed strategies include expanding promotions, product innovation, strengthening partnership networks, and developing export markets. These findings indicate that sorghum processing can enhance the value of local commodities, expand market access, and make a significant economic contribution at the small and medium enterprise level.

Keywords: Added value, sorghum processing, Hayami method, SWOT strategy, agroindustry.

INTRODUCTION

Sorghum (*Sorghum bicolor L. Moench*) is a tropical cereal crop known for its drought resistance and ability to grow on marginal land. It is one of the world's five major cereals, after wheat, rice, corn, and barley (Dicko et al., 2006). In Indonesia, sorghum is beginning to be considered as an alternative food crop to support national food security, particularly in the face of climate change and limited water resources.

Sorghum has a balanced nutritional composition, including complex carbohydrates, protein, minerals (such as calcium, phosphorus, and iron), and bioactive compounds like tannins and antioxidants. Additionally, Sorghum is also gluten-free, making it suitable for individuals with celiac disease or gluten intolerance (Awika & Rooney, 2004), thereby expanding its potential in health-based food markets. These characteristics open up opportunities for sorghum as a source of functional foods and raw materials for various health-based processed food products.

However, the utilization of sorghum in Indonesia remains very limited. National sorghum production is still low, and its use is primarily in the form of raw seeds. However, only a small number of producers in Indonesia engage in value-added sorghum processing, such as the production of flour, rice, or syrup. Yet, such processing could enhance economic value, extend shelf life, and expand market opportunities (Idsan et al., 2020). The added value from the processing can also increase the income of farmers and small businesses, as well as create jobs in rural areas.

Amid rising demand for health-conscious foods and efforts to reduce wheat imports currently exceeding 11 million tons annually (BPS, 2022) the development of sorghum-based products offers strategic opportunities for import substitution and strengthening local food systems. In addition to supporting import substitution, this also strengthens the local food system based on domestic resource potential.

CV Sorgum, a local agro-industrial enterprise in Pangkep Regency, South Sulawesi, exemplifies efforts to process sorghum seeds into rice and flour. However, scaling this

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initiative requires a deeper understanding of its economic value and appropriate development strategies. This initiative demonstrates the potential of the sorghum agroindustry at the local level. However, to scale up operations and enhance competitiveness, a deeper understanding of economic value addition and the formulation of appropriate business development strategies are required.

Comprehensive value chain and economic analyses are essential to determine the contribution of each production stage to overall value addition. The Hayami method is commonly employed for this purpose, as it quantifies value added based on factor inputs, labor, and processing costs (Hayami et al., 1987). In addition, SWOT analysis can be used to identify strengths, weaknesses, opportunities, and threats that affect business sustainability, as well as a basis for designing adaptive development strategies based on local potential (Indarwati et al., 2015).

Strengthening sorghum-based agroindustry supports not only economic value creation but also rural development, food security, distribution efficiency, and the reduction of post-harvest losses (Ardiansyah et al., 2021).

Based on this background, this study aims to: (i) analyze the added value of processing sorghum into rice and flour at CV Sorgum in Pangkep Regency using the Hayami method, and (ii) formulate a strategy for developing sorghum processing based on SWOT analysis.

MATERIALS AND METHODS

***Time and location of research*:** This study was conducted in March 2024 at CV Sorgum, located in Pangkep Regency, South Sulawesi. This location was chosen purposively because CV Sorgum is the only small and medium-sized enterprise (SME) in the region that actively processes sorghum into various processed products such as sorghum rice and sorghum flour.

***Respondent selection*:** Respondents were selected using judgment sampling, with the owner of CV Sorgum chosen as the primary respondent. The business owner was deemed to have the most comprehensive understanding of the entire production process, input usage, labor, costs, and development strategies applied in the sorghum processing business.

***Data collection techniques*:** Primary data was collected through semi-structured interviews using a questionnaire supplemented with a Likert scale to assess internal and external factors in the SWOT analysis. Additionally, direct observations were made of the sorghum processing process, along with documentation in the form of production records, raw material prices, labor usage, and other costs. Secondary data was obtained from internal company documents, relevant literature, and data from related agencies.

***Data analysis method*:** Value-added analysis was conducted using the Hayami approach, which measures the economic value generated from the processing of raw materials into final products. Value-added is calculated as the difference between output value and total input costs (excluding labor). Output value is obtained by multiplying the quantity of final products by the selling price per unit, while inputs include primary raw materials and other inputs such as energy, packaging, and equipment depreciation.

Several parameters are used in this analysis, including:

- Conversion factor, which is the ratio between output quantity and input quantity (kg of product/kg of raw material).
- Labor coefficient, which is the amount of labor used per unit of input (HOK/kg).
- Labor compensation, calculated by multiplying the labor coefficient by the average wage per HOK.
- Value-added ratio, which is the percentage of value added relative to output value, reflecting the efficiency of the processing process.
- Profit, obtained from the difference between value added and labor compensation, which is then analyzed as the profit-to-value-added ratio.
- Margin, which is the difference between output value and raw material costs, which is then used to determine the contribution of labor (labor income to margin), the contribution of other inputs, and the owner's profit.

The classification of value-added levels is based on the following criteria:(Hayami et al., 1987), namely: <15% is classified as low, 15-40% is moderate, and >40% is high.

***SWOT analysis*:** SWOT analysis is used to identify strengths, weaknesses, opportunities, and threats that affect the development of sorghum processing businesses. The IFAS matrix is based on internal factors (strengths and weaknesses), while the EFAS matrix is based on external factors (opportunities and threats). Scores are assigned using a likert scale to assess the level of influence and importance of each factor. Strategies are developed based on the SWOT quadrants: SO, WO, ST, and WT, in accordance with the approach (Rangkuti, 2008).

RESULTS AND DISCUSSION

***Added value*:** The main raw material in the processing is sorghum seeds obtained from local farmers in Labakkang District, Pangkep. The availability of this raw material is still seasonal and highly dependent on the production capacity of farmers, who are not yet fully independent. This causes supply instability and occasionally halts production at CV Sorgum.

The sorghum rice production process involves several stages: sun-drying the seeds until they reach a moisture content of 12-14%, followed by husking to separate the husk, and finally packaging in plastic bags. Meanwhile, the sorghum flour

production process consists of drying, husking, soaking for 12 hours, draining, grinding to a fine consistency (100 mesh size), sifting, and packaging using a vacuum sealer. This process is repeated to produce homogeneous, high-quality flour.

Value-added analysis using the Hayami method is presented in Table 1, showing that the value added from sorghum rice processing reaches Rp 6,137.88/kg (40% ratio), while the value added from sorghum flour processing reaches Rp 12,796.04/kg (57% ratio). Labor compensation for sorghum rice is Rp 4,923.10/kg, while for sorghum flour it is Rp 8,000/kg. The profit margins are Rp 1,884.62/kg and Rp 19,000/kg, respectively. These values are further detailed in Table 1, which shows the input, output, and profit structure of processing:

Table 1. Added value of sorghum processing.

Added Value of Sorghum Processing	Sorghum Rice	Sorghum Flour
I. Outputs, Inputs and Prices		
1. Output (Kg/day)	20	12
2. Input (Kg/day)	26	16
3. Labor (HOK/day)	2	2
4. Conversion Factor (Kg)	0,77	0,75
5. Labor Coefficient (HOK/Kg)	0,077	0,13
6. Output Price (Rp/Kg)	20000	30000
7. Average Wage of Labor (Rp/HOK)	64000	64000
II. Revenue and Profit		
8. Raw material price (Rp/Kg)	3500	3500
9. Price of other inputs (Rp/Kg)	5746,74	6203,96
10. Output Value (Rp/Kg)	15384,62	22500
11. a. Added Value (Rp/Kg)	6137,88	12796,04
b. Value-added ratio (%)	0,4	0,57
12. a. Labor Cost (Rp/Kg)	4923,1	8000
b. Labor Ratio (%)	0,8	0,63
13. a. Profit (Rp/Kg)	1214,8	4796,04
b. Profit Ratio (%)	0,2	0,37
III. Returns to Owners of Factors of Production		
14. Margin (Rp/Kg)	1884,62	19000
a. Labor Income (%)	0,41	0,42
b. Other Input Contribution (%)	0,48	0,33
c. Company Owner's Profit (%)	0,1	0,25

Source: Data Processing, 2024

Value added is the difference between the selling price of a product and the total input costs. The highest value added comes from sorghum flour. This finding is in line with (Deribe & Kassa 2021; Idsan et al., 2020; Indrawati, 2015) which emphasizes that the efficiency of the processing and product quality significantly affect the increase in sales value. Research (Rashwan et al., 2021) emphasizing the importance of developing sorghum processing technology into functional and ready-to-eat food ingredients to enhance product competitiveness. This indicates that sorghum flour processing has higher profitability potential, although its contribution to labor is lower compared to sorghum rice. The higher added value of sorghum flour products compared to sorghum rice shows that innovation and technology in product processing have a significant impact on increasing sales value, production efficiency, and competitiveness in the market (Gunawan et al., 2022). Product innovations such as these can increase sales value while meeting consumer demand for healthy food.

The higher added value of sorghum flour compared to sorghum rice reflects the crucial role of innovation in driving the economic value of local commodities. This difference is not solely due to the final product form but rather the level of processing complexity, functional diversification, and product utility. Processing innovations, particularly those transforming product forms into industrial food raw materials like flour, can create broader multiplier effects, including improved production efficiency, market expansion, and increased profit margins (Istianah et al., 2018). Sorghum flour, for example, has broader market potential because it can be used as a substitute for wheat flour in the bread, cake, noodle, and gluten-free food industries, thereby reaching a larger and higher-value market segment (Aguiar et al., 2023). (George et al., 2022; Pereira & Hawkes, 2022; Riset & Firmansyah, 2023) Furthermore, the high added value of sorghum flour indicates that local commodities such as sorghum are no longer valued solely as traditional foodstuffs, but have strategic potential as future agro-industrial commodities that are adaptable to modern consumer trends, such as healthy, functional, and sustainable foods. This serves as evidence that increasing value through product innovation is not only important for boosting the income of business operators but also a key strategy in promoting locally-based agricultural industrialization, reducing dependence on imported food industry raw materials, and strengthening national economic independence and resilience.

***SWOT development strategy*:** To formulate the appropriate strategy, the combination of strengths, weaknesses, opportunities, and threats is outlined in the following SWOT Matrix. The SO, WO, ST, and WT strategies provide tactical guidance that can serve as a basis for decision-making by CV Sorgum management.

The assessment of internal and external factors, including strengths, weaknesses, opportunities,and threats, is outlined in Table 3 IFAS and EFAS Matrix. This table shows that the strength of the product, namely rice being favored by consumers, has the highest score, while the greatest weakness stems from insufficient promotion efforts. Meanwhile, the highest scores are for export opportunities and product diversification, while the greatest threat arises from the low level of public awareness regarding sorghum products.

The SWOT analysis presented in Figure 1 shows that CV Sorgum is in Quadrant I with a strength and weakness difference of 0.17 and an opportunity and threat difference of 0.5.

Table 2. Matriks SWOT CV Sorgum.

Internal / External	Stregth	Weakness
	1. Products Favored by Consumers 2. Products produced are varied	1. Promotion needs to be improved 2. Lack of partners 3. Lack of government support
Opportunity 1. Export opportunities to international markets 2. Potential diversification of processed sorghum products 3. No competitors yet 4. High market demand	SO strategy Using strengths to take advantage of opportunities 1. Utilize products that consumers like to export. 2. Product innovation to fill markets where there are no competitors. 3. Develop product promotion in local and international markets.	WO Strategy Overcoming weaknesses by taking advantage of opportunities 1. Capitalize on export opportunities with better promotion. 2. Develop partnerships for product diversification. 3. Using high market demand to gain government support.
Threats 1. Many people are not familiar with the product 2. Fear of not succeeding 3. People do not understand the potential of sorghum	ST Strategy Using strengths to avoid threats 1. Use product popularity to educate the public. 2. Develop product diversification to overcome fear of failure. 3. Intensive promotion using varied products. 4. Collaboration with influencers and communities. 5. Organizing events and product exhibitions.	WT Strategy Minimizing weaknesses and avoiding threats 1. Intensive promotional campaign to raise awareness. 2. Build partnerships to support promotion and education. 3. Apply for government support based on market data. 4. Educate the public to reduce fear and increase understanding.

Source: Data Processing, 2024

Table 3. IFAS and EFAS Matrix.

	Weight	Rating	Score
IFAS Matrix			
Strength			
Rice is Popular with Consumers	0,57	4	2,29
Varied Products	0,43	3	1,29
Sub Total	1		3,57
Weakness			
Promotion needs to be improved	0,40	4	1,60
Lack of partners	0,30	3	0,90
Lack of government support	0,30	3	0,90
Sub Total	1,00		3,40
Total	6,97		
EFAS Matrix			
Opportunity	**Weight**	**Rating**	**Score**
Export opportunities to international markets	0,28	4	1,11
Potential diversification of processed sorghum products	0,22	4	0,89
No competitors yet	0,28	3	0,83
High market demand	0,22	3	0,67
Sub Total	1		3,50
Threats	**Weight**	**Rating**	**Score**
Many consumers are not familiar with the product	0,33	3	1
Fear of not succeeding	0,33	3	1
People do not understand the potential of sorghum	0,33	3	1
Sub Total	1		3
Total	6,50		

Source: Data Processing, 2024

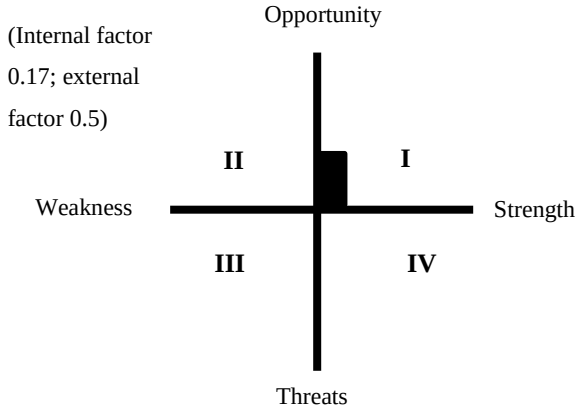

Figure 1. SWOT analysis diagram.

The SWOT analysis shows that CV Sorgum is in Quadrant I, which is an aggressive strategy. This reflects that the company has internal strengths that can be leveraged to capture external opportunities. A strength score of 3.57 and a weakness score of 3.40 result in a positive difference (+0.17), while an opportunity score of 3.50 and a threat score of 3.00 yield a difference of +0.50. This indicates that the appropriate strategy is an aggressive (growth-oriented) strategy, which involves leveraging internal strengths to capitalize on external opportunities. This position suggests that CV Sorgum should adopt an expansive and innovative development strategy (Deribe & Kassa, 2020) emphasizing that sorghum-based

agroindustry in such a strategic position needs to optimize the value chain through process innovation and strengthening partnerships. In the Indonesian context, this can be implemented by expanding production capacity, collaborating with local farmers, and developing processed products with high market value. Agroindustrial businesses in the SWOT Quadrant I position generally succeed in developing their businesses through strengthening product quality and market penetration based on differentiation. In the case of CV Sorgum, export market opportunities and functional food trends are important assets in this strategy (Zhang et al., 2024). This proves that the development of the sweet sorghum industry on a regional scale has significant economic and ecological impacts when supported by an integrated aggressive strategy. SO (Strength-Opportunity) strategies such as brand development, exports, and product diversification are highly appropriate in this context.

Therefore, the SWOT strategies formulated, such as product innovation, intensive promotion, strengthening partnership networks, and market education, are not only relevant locally but also align with global approaches in the development of sustainable agroindustry (Hu et al., 2022; Rashwan et al., 2021). Product innovation and promotion strategies play an important role in expanding markets and increasing sales. According to (Hu et al., 2022) Converting sorghum into high-value products can encourage import substitution, create income diversification for farmers, and reduce biomass waste. Thus, developing sorghum processing businesses not only provides economic benefits but also supports environmental sustainability. By optimizing value addition and implementing appropriate SWOT-based strategies, sorghum processing businesses at CV Sorgum can expand their market reach, increase business operators' income, and strengthen their contribution to food security and the well-being of local farmers.

According to (Sopian & Oesman, 2023), to compete in the export market, producers must improve product quality and keep up with demand trends. Product diversification and strong brand development are also necessary to raise awareness of sorghum products. Research (Ningrum et al., 2020; Ryandi, 2023) reinforces that innovation influences marketing performance and consumer purchasing decisions. Effective promotion, as described by (Maulidasari & Damrus, 2021; Parasari et al., 2024) has been proven to increase consumer awareness and support sales volume growth.

By optimizing added value and SWOT-based development strategies, CV Sorgum's sorghum processing business can expand its market, increase business income, and strengthen its contribution to food security and the welfare of local farmers.

***Conclusion*:** The processing of sorghum into rice and flour at CV Sorgum has proven to provide high economic added value, with added value ratios of 40% and 57%, respectively. Sorghum flour generates greater profit margins, but sorghum rice contributes more significantly to employment. Both types of products have good prospects for development as part of efforts to diversify food sources and increase farmers' incomes. The SWOT analysis results indicate that the strategic development position is in Quadrant I, recommending an aggressive strategy. Proposed strategies include improving product quality, innovation, market-based promotion, and strengthening partnerships and government support. It is recommended that CV Sorgum increase production capacity, diversify sorghum-based products, expand marketing networks, and optimize digital media as a promotional tool. Additionally, collaboration with research institutions and local governments is crucial to strengthen the business position and reach a broader market.

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***SDGs addressed*:** No Poverty; Zero

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